Proposed State of Iowa Stream Mitigation Method

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This document has been modified from the 2013 Missouri Stream Mitigation Method by the Iowa Department of Natural Resources in consultation with the US Army Corps of Engineers (USACE). This proposed method has not been formally submitted to the Interagency Review Team or the USACE.

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A. Introduction

This document describes the method for quantifying unavoidable stream impacts associated with the review of permit applications submitted for authorization under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act. The Iowa Stream Mitigation Method (ISMM) will typically be applied on those permit evaluations where a pre-construction notification is required to be submitted to the Corps, and the Corps determines that compensatory mitigation is necessary to offset unavoidable stream impacts associated with the permit evaluation. Section 332.3(f) of the Corps and USEPA joint regulation for Compensatory Mitigation for Losses of Aquatic Resource; Final Rule (Federal Register / Vol. 73, No. 70 Pages 19594-19687, April 10, 2008) (herein referred to as Mitigation Rule), specifies that functional or condition assessment methods or other suitable metrics should be used where practicable to determine how much compensatory mitigation is required. Therefore, this document has been developed and modified using best available information and applies scientific concepts to assist regulatory agency personnel in determining a value which represents the loss of aquatic functions at an impact or project site (debits).

Another key element of the ISMM is to address the requirements for making a determination of credits identified in Section 332.4 (c)(6) of the Mitigation Rule and the ISMM does not replace any other mitigation plan requirements or components identified in the rule. All mitigation plan documentation must be prepared in accordance with the Mitigation Rule, which governs planning, implementation, and management of permittee-responsible and third party compensatory mitigation projects. Therefore, the ISMM is intended to serve as a tool for determining the amount of stream mitigation credits that a proposed project will generate based on the mitigation plan prepared for Stream Mitigation Banks, Individual In-Lieu Fee Stream Project Approvals, or Permittee-Responsible Mitigation Sites within the State of Iowa.

This method has been established to supplement current policy and provide a consistent rationale to determine appropriate compensatory stream mitigation. Although this method does not require detailed geomorphic, hydrologic, biologic, or chemical assessments at all project sites, careful assessment of existing conditions, quantified estimation of environmental lift using appropriate scientific methodology, and post-construction monitoring, are highly encouraged and may be necessary to ensure project success in some cases. This will be the preferred method when assessing mitigation requirements for all types of stream systems (perennial, intermittent, and ephemeral) that contain an ordinary high water mark and are determined to be jurisdictional "Waters of the United States" as defined by 33 CFR 328.3 (streams are natural, man-altered, or man-made tributaries that flow directly or indirectly into traditional navigable waters). **In some cases, the evaluation of the permit application may reveal the proposed stream compensation measures are not practical, constructible, or ecologically desirable; therefore, all determinations involving projects requiring stream mitigation will be made on a case-by-case basis at the discretion of the reviewing Corps district.**

The policies and regulations regarding mitigation can change, and it is possible that new guidance will result in periodic modifications to this ISMM. Efforts have been made in the preparation of this document to incorporate the most recent Corps policy. If a discrepancy with any relevant Corps policy is discovered, users should notify the Corps of the item and the Corps will review relevant policy, obtain clarification, and modify this ISMM as necessary.

A1. Regulatory Authorities & Guidelines

Authority for implementing the ISMM is granted through the following:

Section 10 of the Rivers and Harbors Act of 1899 authorizes the Corps of Engineers to regulate all work in, over, and under navigable waters of the United States.

Section 404 of the Clean Water Act, as amended in 1977, authorizes the Corps of Engineers to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. The purpose of the Clean Water Act is to restore and maintain the physical, chemical, and biological integrity of the nation's waters.

Section 230.10 (d) of the Section 404 (b)(1) Guidelines states that "no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem." The Section 404 (b)(1) guidelines require that every effort must be made to first, avoid impacts, and second, to minimize impacts. Compensatory mitigation is required for unavoidable adverse impacts, which remain after all appropriate and practicable avoidance and minimization has been achieved.

Section 401 of the Clean Water Act provides authority to each state to issue a 401 Water Quality Certification for any project that needs a federal license or permit to conduct any activity which may result in any discharge. To provide consistency to applicants, the ISMM will also assist the Iowa Department of Natural Resources (IDNR) in their evaluation of projects for Section 401 state water quality certification. The 401 Certification is verification by the state that the project will not violate water quality standards. IDNR works with applicants to avoid and minimize impacts to waters. As part of the 401 Certification, IDNR may require actions on projects to protect water quality as a condition of the certification.

Relationship to other federal, tribal, state, local programs: except for projects undertaken by federal agencies, or where federal funding is specifically authorized to provide compensatory mitigation, federally funded conservation projects undertaken for purposes other than compensatory mitigation cannot be used for the purpose of generating compensatory mitigation credits for activities authorized by Department of the Army permits. However, compensatory mitigation credits may be generated by activities undertaken in conjunction with, but supplemental to, such programs in order to maximize the overall ecological benefits of the conservation project (See regulations at 33 CFR 332.3 (j) and 40 CFR 230.93 (j)). If a supplemental ecological benefit cannot be identified to the federally funded conservation project undertaken for purposes other than compensatory mitigation, then compensatory mitigation credit cannot be given.

The ISMM is not certified for use in Corps Civil Works ecosystem restoration and mitigation projects. The Corps uses a Model Certification process known as the Planning Models Improvement Program (PMIP) to review, improve and validate analytical tools and models for Corps Civil Works business programs [Engineering Circular (EC) 1105-2-407]. The EC requires use of certified models for all planning activities and tasks the Ecosystem Restoration Planning Center of Expertise (ECO-PCX) to evaluate the technical soundness of models used in ecosystem restoration and mitigation projects. The ISMM is not encumbered by the EC and will undergo separate evaluation by ECO-PCX should Corps Civil Works Planning have an interest in using this methodology.

Compensatory Mitigation for Losses of Aquatic Resources, Final Rule, dated 10 April 2008, are the regulations governing compensatory mitigation for activities authorized by permits issued by the

Department of the Army. The regulations establish performance standards and the use of permittee-responsible compensatory mitigation, mitigation banks, and in-lieu programs to improve the quality and success of compensatory mitigation projects. This Final Rule can be found at **33 CFR Parts 325 and 332**. http://www.epa.gov/sites/production/files/2015-03/documents/2008_04_10_wetlands_wetlands_mitigation_final_rule_4_10_08.pdf

Regulatory Guidance Letter (RGL) 05-05 – Ordinary High Water Mark Identification. This document provides guidance for identifying the ordinary high water mark. RGL 05-05 applies to jurisdictional determinations for non-tidal waters under Section 404 of the Clean Water Act and under Sections 9 and 10 of the Rivers and Harbors Act of 1899.

Regulatory Guidance Letter (RGL) 08-03 – Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Establishment, Restoration, and/or Enhancement of Aquatic Resources. This document provides guidance on minimum monitoring requirements for compensatory mitigation projects, including the required content for monitoring reports.

A2. Stream Mitigation Philosophy

The goal of this method is not only to prevent the net loss of stream function when impacts are unavoidable, but also to encourage users to plan carefully to make changes that address the underlying causes of stream instability and contribute to the long-term health of Iowa's waterways. The most successful projects will be those that consider the long-term evolution of stream channels and their surrounding landscapes, and aim to mimic natural systems. Users of this method are encouraged to follow the principles of natural channel design methodology (e.g., Harman and Starr, 2011). If quantitative physical, biological, or chemical data are available, these data will be considered in the review process, and may override qualitative criteria.

A3. Scoring Instructions

The items discussed in sections B (Adverse Impact Factors), C (In-stream Mitigation Credit Factors), and D (Riparian Buffer Work), and E (Fish Passage) assist regulatory agencies, mitigation bankers, in-lieu fee providers, and permit applicants in determining the amount of impact (debits) from the proposed project and mitigation benefits (credits) that are generated as part of a mitigation plan developed in accordance with the Mitigation Rule.

Adverse impacts are calculated using the factors described in Sections B1-B7. A worksheet for performing these calculations is provided in Appendix I-B. Each impact activity should be evaluated separately. Where multiple impacts occur simultaneously along a given stream reach, all impacts should be noted, but only the activity with the highest impact factor should be used in the calculation of debits. Thus, stream reaches with multiple impacts will not be counted more than once.

In-stream and riparian corridor improvements are totaled using the factors listed in sections C, D, and E. Any proposed in-stream mitigation work should be evaluated using the In-stream Worksheet located in Appendix I-C, riparian buffer credit should be calculated using the Riparian Buffer Worksheet located in Appendix I-D, and credit for fish passage should be calculated using the Fish Passage Worksheet in Appendix I-E.

When compensatory mitigation requirements will be fulfilled with an approved third-party mitigation provider, then the Adverse Impact Worksheet (Appendix I-B) will be completed. The total credits required (debits) on the worksheet will be the total credits required for purchase from the mitigation bank or in-lieu-fee program. For permittee-responsible mitigation to be acceptable to the Corps, the mitigation credits discussed in Sections C, D, and E, and those credits generated from the evaluation of a compensatory mitigation plan, should equal or exceed the total credits required on the Adverse Impact Worksheet. The worksheet in Appendix I-A is provided as a summary of the detailed worksheets (I-B – I-E).

User Note: Mitigation credits generated as part of a permittee-responsible mitigation plan should be equal to or greater than the required credits calculated on the Adverse Impact Factors Worksheet. Any mitigation credit shortage may be compensated by modifying the mitigation plan in an attempt to accrue more mitigation credit, purchasing of credits from an approved mitigation bank, paying a fee to an approved in-lieu fee provider, or combination thereof. Final decisions regarding how or where any mitigation credit shortage shall be compensated rest with the Corps.

B. Adverse Impact Factors

The items discussed in this section assist the Regulatory agencies and permit applicants in determining the adverse impacts of a project and the amount of mitigation required to offset stream losses within the permit area.

B1. Stream Types

Streams are classified into one of three categories based on the long-term status of the stream, not observations from a single year.

Stream Type	Adverse Impact Factor	In-stream Benefit Factor
Ephemeral	0.3	0.15
Intermittent	0.4	0.2
Perennial	0.8	0.4

<u>Ephemeral Streams</u>
(Impact factor = 0.3, In-stream benefit factor = 0.15)
Streams that only have flowing water in response to precipitation events during a normal precipitation year. Ephemeral streambeds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from precipitation is the primary source of water for stream flow. Ephemeral streams typically support few aquatic organisms. When aquatic organisms are found they typically have a very short aquatic life stage.

<u>Intermittent Streams</u>
(Impact factor = 0.4, In-stream benefit factor = 0.2)
Streams that have flowing water during times of the year when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from precipitation is a supplemental source of water for stream flow. The biological community of intermittent streams is composed of species that are aquatic during a part of their life history or move to perennial water sources. Intermittent streams with perennial pools are included in this category.

<u>Perennial Streams</u>
(Impact factor = 0.8, In-stream benefit factor = 0.4)
Perennial streams have flowing water year-round during a normal precipitation year. The water table is located above the streambed for most of the year. Groundwater is a primary source of water for stream flow. Runoff from precipitation is a supplemental source of water for stream flow. Perennial streams support aquatic organisms year-round.

Mapping: All stream segments included in IDNR's "stream order" coverage are considered perennial unless the applicant provides data justifying a different classification. These can be found in the Natural Resources Geographical Information Systems (NRGIS) library (https://programs.iowadnr.gov/nrgislibx/) under State-wide Data/Hydrologic/Surface Waters.

B2. Priority Waters

The value of the stream is categorized for the purpose of determining adverse impact and also for determining the in-stream benefits of mitigation. This classification is designed to protect those areas with significant ecological, recreational, hydrological, or socio-economic value. As new technology and new assessment information is available, a stream may be reclassified on a case-by-case basis. The priority waters are divided into three categories: primary, secondary, and tertiary.

Priority Waters	Adverse Impact Factor	In-stream Benefit Factor
Primary	0.8	0.4
Secondary	0.4	0.2
Tertiary	0.1	0.05

Primary

(Impact factor = 0.8, In-stream benefit factor = 0.4)
These streams provide important contributions to biodiversity on an ecosystem scale or high levels of function contributing to landscape or human values. Impacts to these streams should be rigorously avoided or minimized. If a primary stream must be impacted, compensation for impacts should emphasize replacement nearby and in the same watershed. Designated primary priority waters include:

- Outstanding National Resource Waters - currently none listed in Iowa
- Outstanding Iowa Waters*: http://www.iowadnr.gov/InsideDNR/RegulatoryWater/WaterQualityStandards/Antidegradation.aspx#dltop
- Iowa Protected Water Areas*: http://www.iowadnr.gov/Recreation/CanoeingKayaking/StreamCare/ProtectedWaterAreas.aspx
- Known mussel beds**
- Waters with known populations of state or federally listed Endangered and Threatened species**

*These coverages are available for download from the NRGIS library (https://programs.iowadnr.gov/nrgislibx/) under State-Wide Data/Hydrologic/Surface Waters. Should one require data that cannot be located on the referenced site, the data will be made available upon request, barring any legal or security restrictions. Also for individuals without geospatial software, the IDNR hosts interactive mapping services at http://www.iowadnr.gov/Environment/GeologyMapping/MappingGIS.aspx.

** These areas are determined on a case by case basis in coordination with the USFWS- Ecological Services Office which can be reached at (309) 757-5800 and an IDNR environmental reviewer. Instructions for requesting a state environmental review prior to permit application can be found at http://www.iowadnr.gov/Conservation/Threatened-Endangered/Environmental-Reviews

Current list of state endangered, threatened, and special concern species:
571 IAC chapter 77.2: List of Animals
571 IAC chapter 77.3: List of Plants

Secondary

(Impact factor = 0.4, In-stream benefit factor = 0.2)
Secondary priority waters include:

- Areas known to be important to life cycles of aquatic Species of Greatest Conservation Need listed in Table 3-8 and 3-9 listed in the most recently updated Iowa Wildlife Action Plan: http://www.iowadnr.gov/Environment/WildlifeStewardship/IowaWildlifeActionPlan.aspx.

- Rivers and streams abutting an approved mitigation site (bank, in-lieu fee, or permittee-responsible)
- Rivers and streams of the same or lower order upstream or downstream of primary priority waters, if the project is determined likely to affect the priority water.
- Rivers, streams, or identified segments that are not ranked as a primary priority waters but are designated by the Corps District (see Appendix III).
- Stream within 2 stream miles up- or downstream of waters located within lands under public ownership or holdings

Tertiary

(Impact factor = 0.1, In-stream benefit factor = 0.05)
These areas include all other freshwater systems not ranked as primary or secondary priority waters.

B3. Existing Condition

The existing functionality of each stream segment is assessed where an impact activity is proposed. Streams are assumed to be moderately functional unless the stream is determined to be fully functional or functionally impaired, as described below.

Existing Condition	Adverse Impact Factor
Fully Functional	1.6
Moderately Functional	0.8
Functionally Impaired	0.2

Fully Functional

(Impact factor = 1.6)
These are stream segments that have been shown to, or are likely to, support healthy aquatic communities. These stream segments also have natural hydrologic variability and responses to precipitation events. Fully functional stream segments are characterized by a combination of little modification, relatively stable bed and banks, lacking artificial dam structures, water quality sufficient to support diverse aquatic life, and undisturbed riparian corridors. A fully functional stream represents a least-disturbed condition and therefore exhibits the conditions used to establish performance standards for restoration and mitigation.

The stream segment is considered fully functional IF:
1) monitoring data indicate that the stream has the capacity to support an exceptional biological community based on any of the following three criteria:

- One or more assessments of the Ecoregionally-adjusted Fish Habitat Index (EFHI) within 1.5 miles of the stream segment have resulted in a score exceeding 60 based on physical habitat assessment data within the past 10 years. These stream segments are capable of supporting a fish assemblage that is considered “very good” or “excellent” by the DNR’s Fish Index of Biotic Integrity (FIBI). Iowa DNR’s Standardized Operating Procedures for collecting biological sampling and physical habitat assessment data can be found here: http://publications.iowa.gov/20274/.

- One or more biological assessments of the stream within 1.5 stream miles of the segment has resulted in an score within the “excellent” category using the DNR’s benthic macroinvertebrate index of biotic integrity (BMIBI), fish (FIBI), or freshwater mussels (MIBI) within the past 10 years. The BMIBI and FIBI scores are currently housed in the DNR’s BioNet database (https://programs.iowadnr.gov/bionet/). Until the MIBI scores become available in BioNet, these scores can be obtained by contacting Iowa DNR water monitoring staff.

- The **non-wadeable** (drainage areas greater than 500 square miles) stream is classified as “fully supporting” its designated aquatic life use based on the Iowa DNR biological assessment methodology, which can be found in Attachment 2 of Iowa DNR’s methodology for water quality assessments and impaired waters listings pursuant to sections 305(b) and 303(d) of the Federal Clean Water Act (see http://www.iowadnr.gov/Environmental-Protection/Water-Quality/Water-Monitoring/Impaired-Waters). These listing are available in the Iowa DNR's Water Quality Assessment database, ADBNet (https://programs.iowadnr.gov/adbnet/index.aspx), which can also be accessed through BioNet.

OR, 2) all of the following criteria are met:

- Is unaltered in any significant manner by human activities. It has not been channelized, impounded, or significantly constricted by structures, or had its flow significantly altered.
- Is not impaired for aquatic use as defined by the most current Clean Water Act Section 305(b)/303(d) Integrated lists as Category 4 or 5 as developed by IDNR. http://www.dnr.ia.gov/env/wpp/waterquality/305b/index.html
- Is stable and does not exhibit head cutting, incision, or excessive aggradation and the stream banks are not subject to excessive erosion or disturbance.
- Is connected to its overbank floodplain supporting normal hydrological functions.
- Has a riparian buffer of at least 50 feet in width on both sides of the stream that sustains deep-rooted, native vegetation.
- If a stream segment is impacted by a minor structural alteration along a stream that is otherwise considered fully functional, but the structural alteration does not significantly alter the stream reaches above and below the structure, the segment from 0.25 miles above to 0.25 miles below the alteration should be considered a separate segment that is moderately functional.

Exception: The Corps, at its discretion, may designate the largest streams within an Ecological Drainage Unit or 8-digit Hydrologic Unit Code (HUC) as fully functional, regardless of whether they meet the criteria above, based on the stream's recreational, commercial, or water supply values. See Appendix III for any District designations.

Moderately Functional

(Impact factor = 0.8)
These are streams that show a limited degree of disturbance; however, system recovery has a moderate probability of occurring naturally. These streams support many, but not all, of the hydraulic and geomorphic functions characteristic of fully functioning streams of similar order in the watershed. All stream segments that **do not meet** the definition of fully functional or **do not have** the characteristics of a functionally impaired stream segment are considered moderately functional.

Functionally Impaired

(Impact factor = 0.2)
These streams that have been degraded and lack resilience characterized by loss of one or more functions. Recovery is unlikely to occur naturally unless a substantial rehabilitation project is undertaken.

A stream segment may be considered functionally impaired if it fails to meet a Fully Functional condition and meets two or more of the following criteria:

- All BMIBI (benthic macroinvertebrates), FIBI (fish) and MIBI (freshwater mussels) scores calculated from samples on the stream segment, or within 1.5 miles of the stream segment, in the past 10 years fall into the "poor" category unless there is evidence of chemical water quality impairment(s) that results in less aquatic life than expected given the available habitat. The BMIBI and FIBI scores are currently housed in the DNR's BioNet database (https://programs.iowadnr.gov/bionet/). Until the MIBI scored become available in BioNet, these scores can be obtained by contacting Iowa DNR water monitoring staff.

- Has been channelized and shows no evidence of self-recovery.
- Is protected by a levee, impounded, or artificially constricted.
- Is entrenched or contains active head-cuts (i.e. abrupt drops in stream bed, both banks failing).
- Has less than 25 feet of riparian buffer of deep-rooted vegetation on one or both sides of the stream channel.
- Has banks that are extensively eroded or unstable with obvious bank sloughing and/or erosional scars.
- Has four or more stream impacts within 0.5 miles upstream of the proposed stream impact including culverts, pipes, or other manmade modifications, and stream impacts individually or cumulatively exceeds 100 feet in length.

B4. Impact Duration

The amount of time the impact activity is expected to last is divided into the two categories: temporary and permanent.

Impact Duration	Adverse Impact Factor
Temporary	0.05
Permanent	0.3

Temporary
(Impact factor = 0.05)
The construction activity will continue for a period of less than 9 months with system integrity recovering after cessation of the permitted activity or restoration to pre-construction contours and elevations. Examples of activities eligible to receive a temporary duration factor include utility line crossings where natural substrate is used to backfill an open-cut trench, temporary stream diversions, temporary road crossings, work pads, or cofferdams.

User Note: Compensatory mitigation is not normally required for temporary impacts; however, in some cases, the amount, location, and type of impacts may necessitate mitigation to ensure that impacts are not adverse. At the Corps discretion, impacts that affect the stream for up to 2 years may be considered temporary when best management practices are in place to minimize adverse effects.

Permanent
(Impact factor = 0.3)
The impact activity will result in the permanent loss of some or all aquatic resource function and/or services. Examples include armoring, culvert installation, detention facilities, morphological changes, impounding, and piping.

B5. Impact Activity

The following are considered impact activities:

Impact Activity	Adverse Impact Factor
Fill	2.5
Pipe	2.2
Impoundment	2.0
Morphologic change	1.5
Detention facility	0.75
Below grade culvert	0.3
Temporary disturbance	0.15
Armored revetments/walls	0.1
Clearing	0.05

Fill
(Impact factor = 2.5)
Filling of a stream channel including the relocation of a stream channel (even if a new stream channel is constructed).

Pipe
(Impact factor = 2.2)
Routing a stream through pipes, box culverts, or other enclosed structures.

User Note: If a piped channel section fails to follow the existing channel alignment, the Regulatory

Project Manager will determine whether the “pipe” or “fill” impact activity factor will be used.

Impoundment

(Impact factor = 2.0)

Conversion of stream(s) to open water (pond or lake) through the construction of a dam or similar structure that modifies the natural stream flow, reduces fish passage, and interrupts transport of sediment. Channel impacts where the structure is located are considered a “fill” activity, and the inundation will be considered as an impoundment.

User note: When identifying impoundment impacts, discretion should be used when the structure is in a small watershed area and the main purpose of the structure is for watershed restoration benefit. Examples include structures used to intercept sediment, slow runoff, create wetlands, stabilize grades, reduce gully erosion, reduce nutrients, etc., as part of a watershed improvement or lake restoration plan.

Morphologic change

(Impact factor = 1.5)

Alteration of the established or natural dimensions, depths, or limits of an existing stream channel through straightening, widening, dredging, excavating, or channelizing (leaving the channel in the same alignment). Examples include creation of a hardened open channel such as one lined with concrete or rip-rap to the top of bank, in-channel grading upstream of a detention structure, conversion of a stream to a grassed waterway, lining parallel banks with gabion baskets, concrete or block retaining walls, or channel reaming activities. Morphologic change does not include river restoration activities which may include modest stabilization of a bank toe with wood or native stone, planting of native vegetation, excavation of low floodplain or breaching of levees, or otherwise restoring a disturbed or degraded channel to a natural form.

Detention facility

(Impact factor = 0.75)

Installation of a stormwater management facility within a stream channel or tributary to the stream channel within 0.25 miles of the impact site which restricts the movements of aquatic life. This facility consists of a detention structure and a temporary ponding area upstream of the detention structure. The detention structure (i.e., dam or berm) itself is considered a “fill” activity as defined above. Water velocities entering the temporary ponding area are typically reduced and may be temporarily held back while outflow is slowly released back into the channel downstream of the detention structure.

User note: When identifying impacts, discretion should be used when the detention structure is in a small watershed area and the main purpose of the structure is for watershed restoration benefit. Examples include structures used to intercept sediment, slow runoff, create wetlands, stabilize grades, reduce gully erosion, reduce nutrients, etc., as part of a watershed improvement or lake restoration plan.

User Note: If the stream channel upslope of the detention structure is straightened, widened, dredged, excavated, or relocated, determination of whether the impact will be characterized as a “morphologic change” or “fill” will be at the Corps’ discretion. When making this determination, the Corps may consider the relative diversity of the stream as relates to movements of aquatic life.

Below-grade (embedded) culvert

(Impact factor = 0.3)

To route a stream through pipes, box culverts, or other enclosed structures for the purpose of a transportation crossing (≤ 100 linear feet of stream to be impacted per linear transportation crossing). New or replacement culverts should be designed to convey geomorphic bankfull discharge at bankfull width with a similar average velocity as upstream and downstream sections. The culvert should be embedded and backfilled below the grade of the stream (≥ 1 foot for culverts greater than 48 inches in diameter). On culverts 48 inches wide or smaller, the bottom of the culvert should be placed at a depth below the natural stream bottom. Bottomless culverts are acceptable in streams with non-erodible beds (i.e. bedrock or stable clay). Culverts that fail to meet the above design criteria will be evaluated under the impact activity known as Pipe (see definition above).

Temporary disturbance
(Impact factor = 0.15)
Includes construction or installation methods that require temporary disturbance of the streambed including pipeline/utility line installation, bridge footings, drilled shafts, column/pier placement, cofferdams for footing/pier placement, temporary crossings and workpads.

Armored revetments / walls
(Impact factor = 0.1)
To riprap one or both stream channel banks to top-of-bank, or the use of other hard methods (e.g., cabled concrete blanket, block retaining wall, or other unnatural structures) on a streambank.

User Note: Armoring of the stream bed and banks with riprap or installing a retaining wall along both channel banks should be assessed as a "Morphologic Change." Keying riprap revetments along the toe is a necessary installation practice under this activity.

Clearing
(Impact factor = 0.05)
Clearing or removal of streambank vegetation or other activities that reduce or eliminate the quality and functions of vegetation within riparian habitat without significantly disturbing the existing topography or soil. Although these impacts may not be directly regulated, mitigation for these activities may be required if the impact is considered part of the Corps' scope of analysis, and impacts occur as a result of, or in association with, an activity requiring a permit.

User Note: This factor is not intended for use in combination with a channel segment where a dominant impact activity is being evaluated. However, an example where this factor may be applicable would be on a linear project that parallels a meandering stream channel and multiple stream crossings are proposed. The Regulatory project manager may require compensatory mitigation for clearing activities within the riparian corridor between these crossings with "clearing" identified as the dominant impact activity.

B6. Linear Impact Calculation

The linear impact calculation is the mathematical calculation used to address the scope of linear impact for each individual column recorded on the Adverse Impact Factor Worksheet. The corresponding value for each column shall be determined by multiplying a 0.0002 constant by the length of stream impacted per column (0.0002 x length of stream impacted per column).

B7. Compensation Ratio

The compensation ratio applies to third-party mitigations only. When the Corps determines that a third party mitigation source is acceptable to fulfill compensatory mitigation requirements, the total credits determined on this worksheet shall be applied to mitigation banks or in-lieu fee programs at a 1:1 ratio when the impact area is within an approved primary service area. However, an increased compensation ratio may be used (as approved by the Corps) when an impact occurs beyond the geographic service area of an approved mitigation bank or in-lieu fee program.

Service Area	Compensation Ratio
Primary	1
Secondary	2
Tertiary	3

C. In-Stream Mitigation Credit Factors

An understanding of stream and riparian functions is required to plan and design successful stream restoration projects. The basic functions that stream and riparian corridors support include: system dynamics, hydrologic balance, sediment processes and character, biologic support, and chemical processes and pathways (Fischenich, 2006). Stream restoration does not necessarily require returning a system to a pre-disturbance condition, as this is seldom feasible (Copeland et al., 2001).

Successful stream channel design or uncovering what restoration technique best fits a given situation is highly dependent on regional and local factors. Stream restoration must account for any potential adjustments in channel form and function that may occur within the watershed as a result of the restoration project. Watershed conditions, site selection, baseline information, mitigation objectives, design alternatives, and other feasibility actions must be considered during permit review as critical components of a compensatory mitigation plan prior to the application of this method. It is important to develop stream mitigation plans in consultation with resource and regulatory agencies and use existing watershed assessments, or other available planning documents to make determinations on the appropriate restoration method.

C1. Stream Type

See section B1.

C2. Priority Waters

See section B2.

C3. Net Benefits

The categories listed below describe the benefits of the proposed mitigation relative to the restoration or enhancement of physical, chemical and/or biological processes that occur in aquatic ecosystems. Net benefits address functional objectives such as hydrologic balance, sediment transport, water quality and biological support in the context of the existing conditions prior to mitigation activities. The Corps will determine on a case-by-case basis the net benefit of the proposed in-stream mitigation action. Each mitigation proposal will be evaluated to ensure that the documentation fulfills the requirements of the Mitigation Rule. Care should be taken not to add in-stream features to a stable or reference quality stream in order to simply generate credits; i.e., stability problems or habitat deficiencies with the stream should be stated and applied methods should respond to those problems. In most cases, use of native construction materials for mitigation, such as stone, wood, and native plants, is preferable over use of concrete, metals, or other manufactured materials.

A stream relocated to a new alignment for purposes of accommodating construction of an authorized project in the stream's former location, may be construed as a net benefit if the relocation objectives balance hydrologic and geomorphic processes while incorporating appropriate design features. Under this circumstance, the Corps will determine on a case-by- case basis whether the net benefit of the proposed mitigation activity will provide no compensation, partial compensation, or full compensation for project impact.

Net Benefits	In-Stream Benefit Factor
Excellent	3.5
Good	2.4
Moderate	1.2
Stream Relocation	0.5

Excellent

(In-stream benefit factor = 3.5)

To be classified as "excellent," a restoration project must address multiple functions of a stream on a large scale. The benefits gained as a result of the mitigation project should be consistent with existing conservation, restoration, or watershed plans. The project should be designed by an experienced stream restoration professional or hydraulic engineer in collaboration with stream biologist familiar with river and stream habitats. Native riparian wetland, valley corridor prairie and woodland buffer plants species, recognized as appropriate to the setting, should be used. A project that proposes to bring a functionally impaired stream up to fully functional status, as predicted by Iowa DNR's Ecoregionally-adjusted Fish Habitat Index (EFHI) protocol or other pre-approved tools, will be considered excellent. For intermittent or wadeable perennial streams these projects should raise the estimated EFHI index two or more categories above the existing habitat quality of the stream reach using habitat assessment data collected within the past 5 years. Iowa DNR's biological sampling and physical habitat assessment SOP can be found at http://publications.iowa.gov/20274/. For ephemeral streams or large non-wadeable streams where the EFHI is not appropriate, other approaches for evaluating environmental lift may be considered. Examples of in-stream activities which could be classified as excellent net benefits include, but are not limited to, the following:

- Removing or modifying dams, weirs, pipes, culverts and other manmade in-stream structures such as low-water crossings in ways that restore the natural river channel to a stable state that is neither aggrading nor degrading and corresponds to reference condition bankfull widths, depths, and planform to relatively similar sinuosity. Habitat considerations and features are incorporated within the project area. Basic criteria for fish passage described in section E also must be considered for all components of project to be considered as mitigation.
- Installation of grade control structures (GCS) that promote fish passage on stream reaches that are channelized or portions of streams suffering significant bed degradation, such as western Iowa's deep loess soil regions. Loose stone structures designed for stability are preferred, but where suitable stone is cost-prohibitive, grouting may be considered. Basic criteria for fish passage described in section E also must be considered for all components of a project to be considered as a mitigation.
- Restoring river and stream floodplains, restoring floodplain connectivity at various recurrence intervals, and naturalizing hard-scaped banks such as abutment walls or riprap revetments. Examples of acceptable projects include creating bankfull (1 to 2 year recurrence) floodplain in highly entrenched stream channels; artificial levee or dike removal, setback, and/or notch where one of these activities itself will reconnect the stream channel to 30 percent or greater of its natural overbank floodplain at up to 50, 100, or 500 year recurrence. Streambanks and floodplains will be planted to regionally native wetland, prairie, and woodland species based on research of successful plantings.
- Restoring stream channel to its former location and/or restoring sinuosity, channel dimensions (width/depth ratio), and bankfull width of a degraded stream reach to appropriate design based on a morphologically stable and appropriate reference stream.
- Stabilizing gully erosion with selected use of woody debris, live wood check structures, and stabilization plantings targeted to minimize blockage to likely fish movement.
- Building a new, stable channel at higher elevation and reconnecting it to its natural overbank floodplain where functionally appropriate.
- Restoring a highly erosive and entrenched gully channel to a step-pool sequence type of channel using native stone and wood materials with thalweg slope not to exceed 5 percent over the restored reach using material sizes deemed to be stable on the design slope.
- Restoring oxbows in low gradient streams where oxbows were formerly found to provide aquatic habitat benefits at locations and designs approved by a DNR fisheries biologist. Because this restoration is not on the immediate channel but contributes to several stream

functions, half the linear feet of oxbow restored can be used in the calculation.

"Excellent Net Benefit" **does not** include the relocation of a stream channel to accommodate a project.

Good

(In-stream benefit factor = 2.4)

A "good" stream restoration project addresses stream function on a smaller scale. The benefits gained as a result of the mitigation project would be localized and not system-wide. Projects on wadeable streams that propose to improve the Ecoregionally-adjusted Fish Habitat Index (EFHI) of the stream reach one category, raising the index score by a minimum of 10 points. Examples of in-stream activities which accrue "good" net benefits include, but are not limited to, the following:

- Removing or modifying dams, weirs, pipes, culverts and other manmade in-stream structures such as low-water crossings in ways that restore the natural river channel to a stable state. Basic criteria for fish passage described in section E also must be considered for all components to be a project to considered for submittal as a mitigation.
- Grade control for all actively downcutting channels regardless of location where no grade control currently exists and the problem can be demonstrated at some level. Basic criteria for fish passage described in section E also must be considered for all components to be a project to considered for submittal as a mitigation. Streambed stabilization can include a combination of methods to counter streambed degradation exhibited by knick points and/or head cuts. Grade control may be achieved with maximum slopes of 5 percent at a minimum thalweg slope. Newbury rock riffles, rock arch rapids, cross vanes, and other structures may be used to control slope.
- Artificial levee or dike removal, setback, and/or notch where one of these activities itself will reconnect the stream channel to its natural overbank floodplain, with less than 30 but greater than 10 percent of the 10-year to 50-year recurrence interval floodplain reconnected across the entire valley.
- Restoring in-stream channel features (i.e., riffle/run/pool/glide habitat) within a reach but not comprehensively rehabilitating the channel, using methodologies appropriate to the stream type, size, location in the watershed and current watershed condition.
- Where appropriate, restoring stability in highly eroded areas or areas with artificially accelerated erosion, by resloping and reshaping banks, applying a relatively small percentage of rock (e.g., stone toe protection), and using non-rigid (soft) methods such as native vegetation. In areas where extreme accelerated erosion is occurring or significant habitat constraints limit biological productivity, more rock structures may be used, but native vegetation must be planted in combination with the rock structures.
- Restoration of off-channel habitats significant to recovery of state or federally listed threatened or endangered species.
- Removal of direct livestock access to stream or alternative practices that are sufficient to reduce pressure from livestock on the stream.

"Good Net Benefit" **does not** include the relocation of a stream channel to accommodate a project in the stream's former location.

Moderate

(In-stream benefit factor = 1.2)

A "moderate" restoration project addresses stream function on a reach-specific scale. In general, these projects are not expected to significant change the existing EFHI score along the entire reach, but will provide localized habitat improvements. Even if applied on a significant length of stream, such practices do not markedly enhance the stream's physical, chemical, and biological processes. Examples of practices which accrue moderate net benefits include, but are not limited to, the following:

- Removing check dams, weirs, car bodies, foreign materials/junk, debris and artificial in- stream structures and/or other structures that are directly contributing to bank erosion, scour or blocking stream processes where significant bed degradation or sediment release is not projected to occur. Grade control may be achieved with maximum slopes of 5 percent at a minimum thalweg slope. Newbury rock riffles, rock arch rapids, cross vanes, and other structures may be used to control slope.
- Where appropriate, using stream stabilization methods that utilize hard natural materials in combination with native vegetation to slow velocities and/or train flow for the purpose of enhancing local channel stability and aquatic habitat. Stabilization methods include toe wood, longitudinal peak stone toe, encapsulated / planted fabric lifts or rolls, stream barbs, cross vanes, straight vanes, j-hook vanes, etc. but *not* rock armoring of streambanks alone. In general, hardened portions of the toe should vary from a maximum of half bankfull elevation to bankfull elevation. Hard natural materials (armoring) may include materials such as native stone or woody debris but not broken concrete, brick, metal, or other non-natural materials.
- Reconnecting abandoned side channels or meanders that were artificially cut off, blocked, or filled where functionally appropriate. Depending on project length, this may be classified as a good stream channel restoration.

"Moderate Net Benefit" **does not** include the relocation of a stream channel to accommodate a project in the stream's former location.

Stream Relocation to Accommodate an Authorized Project
(In-stream benefit factor = 0.5)
This category is for restoration projects that involve the movement/creation of a stream at a new location to allow an authorized project to be constructed in the stream's former location. A stream moved to a new location to accommodate construction of an authorized project should incorporate natural channel design features consistent with a morphologically stable and appropriate reference stream channel including dimension (cross-section), pattern (sinuosity), and profile (slope), and incorporate measures (grade control, in-stream habitat, riparian plantings, etc.) before consideration will be given by the Corps District to accept the relocated channel as compensatory mitigation. Relocated streams will generally require vegetative buffers of sufficient width that can be evaluated for riparian mitigation credit. Relocations resulting in a reduced channel length will generally require additional mitigation to replace net losses of stream channel length.

C4. Site Protection Bonus

Third-party grantee
(Benefit Factor = 0.2)
All land areas included in a mitigation project must be protected from any future changes that would result in loss of stream function. An appropriate legally binding real estate instrument, approved in advance by the Corps, will be required to ensure that the mitigation work, whether in-stream and/or out-of-stream, is protected in perpetuity. Instruments such as conservation easements, deed restrictions, and restrictive covenants, or other alternatives may be appropriate for protecting mitigation work depending on the situation. A site protection bonus will be granted if a qualified third-party guarantees oversight of the property such as in the case of a conservancy, where a title is transferred to a well-established non-profit organization or government agency. **The site protection bonus can only be applied once for a given piece of property regardless of whether both in-stream and riparian activities are planned.**

C5. Credit Schedule

The credit schedule reflects the timing of mitigation activities relative to the timing of impacts and factors vary depending on whether the mitigation credits come from a permitee-responsible mitigation, an in-lieu fee program, or a mitigation bank. This factor can only be used once in the most significant credit-generating worksheet for of the project (in-stream or riparian). For all forms of compensatory mitigation, the following guidelines apply for construction timing.

Credit Schedule 1

(In-stream benefit factor – 0.3, Riparian buffer factor = 0.15)

A **permitee-responsible mitigation** qualifies for Credit Schedule 1 if 80 to 100 percent of the construction and any planting components specified in the mitigation work plan are completed before project-related stream impacts occur.

All **mitigation banks** qualify for Credit Schedule 1. Bank sponsors sell a majority of their credits only after those credits have been released (meaning that the aquatic resources are functioning). In order for credits to be released, the sponsor must submit a monitoring report to the Corps demonstrating that the appropriate performance-based milestones for credit release have been achieved. The Corps in consultation with the IRT determines whether the milestones have been achieved and whether credits can be released.

Credit Schedule 2

(In-stream benefit factor – 0.1, Riparian buffer factor = 0.05)

A **permitee-responsible mitigation** qualifies for Credit Schedule 2 if at least 50 but less than 80 percent of the construction and any planting components specified in the mitigation work plan are completed prior to and/or concurrent with the stream impacts.

Credit Schedule 3

(In-stream benefit factor – 0, Riparian buffer factor = 0)

A **permitee-responsible mitigation** qualifies for Credit Schedule 3 if less than 50 percent of the construction and any planting components specified in the mitigation work plan will be completed prior to and/or concurrent with the stream impacts.

All **in-lieu fee programs** (ILF) qualify for Credit Schedule 3. ILF sponsors generally initiate compensatory mitigation projects only after collecting fees, and there is often a substantial time lag between permitted impacts and implementation of compensatory mitigation projects.

User Note: If an ILF program sponsor obtains Corps approval for an ILF mitigation project in a geographic service area, and all of the advance credits in that service area have been completely fulfilled with release credits from an ILF projector released credits in that service area surpass the debits that have occurred, then, at the discretion of the reviewing Regulatory project manager, a credit schedule 1 or 2 may be acceptable.

C6. Determining Benefited Stream Length

Benefited stream length is expressed as the total linear length in feet that the in-stream mitigation activity will have on the stream channel. This figure shall be applied in the box labeled *Stream Length Benefited* found on the Instream Worksheet located in Appendix I-C. Six guidelines have been established to assist users in determining the appropriate length to apply to the corresponding section of the worksheet.

1. Linear credit will be based on removal or modification of structures such as dams, culverts, or crossings that limit biological movement and associated restoration and grade stabilization work. Increased credit for upstream miles connected shall be considered only via the Fish Passage worksheet and should not be duplicated using the in-stream benefits worksheet, although direct habitat benefits on the site that improve diversity and sensitive species recovery may allow some additional consideration by the reviewer. Mitigation credit will not be granted for activities which may facilitate the spread of aquatic nuisance species. (See Solving Dam Problems, Chapter 3, at http://www.iowadnr.gov/Recreation/CanoeingKayaking/LowHeadDams/DamMitigationSafety.aspx as a reference for dams considered barriers to spread of Asian carp.)
2. Linear credit for installation of localized lateral streambank stabilization measures will be based on the length of the appropriate-sized structure or bank treatment (shaping, toe reinforcement, etc.).
3. Linear credit for artificial levee or dike removal, setback, and/or notch will be based on the longitudinal extent and acreage where overbank flooding will occur along the stream channel and where the sponsor or permittee will place an appropriate legally-binding real estate instrument that is approved by the Corps.
4. Linear credit for grade control structures* will be determined on a case-by-case basis taking into consideration overall benefit of the structure to the watershed, survey information, and existing upstream or downstream structures, and improvement or preservation of fish passage. Selection of an appropriate net benefit factor is also at the sole discretion of the reviewing Corps district. Maximum slope of the downstream side of structures considered will be 20:1, with greater net benefit allowable for lower-slope structures and projects that offer additional stream function benefits such as native riparian plantings, floodplain restoration, or deep water holding areas throughout the structure.
5. Linear credit for stream relocation activities necessary to accommodate authorized projects will be the length of new channel created provided that this activity meets the criteria for consideration of a mitigation activity as described in section (C)(1)(d).
6. Linear credit for all other activities will be determined on a case-by-case basis at the discretion of the reviewing Corps district.

***User Note:** Grade control is required when an in-stream structure is removed in an actively incising channel or when channel length is reduced; therefore, additional credit for the installation of these structures will not be considered or approved.

C7. Location and Kind

The location and kind factors listed below **only apply to permittee-responsible mitigation projects.** Mitigation banks and in-lieu-fee programs cannot be evaluated for this factor because they are planned and approved independently of the impacts for which mitigation banks and in-lieu-fee programs are responsible. Also, when mitigation bank and in-lieu-fee programs are being evaluated, watershed needs are considered which assists in a determination of credit amount and type. This consideration precludes the need to apply the kind portion of this factor. Therefore, when a mitigation bank or in-lieu-fee program is proposed to fulfill the compensatory mitigation requirement, the Adverse Impact Factors Worksheet allows the Corps District to determine whether an increased compensation ratio is needed to account for impacts beyond the geographic service area of mitigation banks or in-lieu fee programs.

In-service-area/In-kind

(In-stream benefit factor = 1.0)

The project is considered "in-service-area" and "in-kind" if both of the following conditions are met:

1) Proposed project is within the 8-digit HUC watershed or the IRT-approved service area in which

the impacts will occur, or the project employs a watershed approach which considers how the type and location of the compensatory mitigation project will provide the desired aquatic resource function.

2) Hydrologic stream types are not interchanged (i.e., ephemeral, intermittent, perennial).

Out-of-service-area/Out-of-kind

(In-stream benefit factor = 0.5)

The project is considered "out-of-service-area" or "out-of-kind" if either of the following conditions are met:

1) Proposed project is outside of the 8-digit Hydrologic Unit Code (HUC) watershed or the IRT-approved service area in which the impacts will occur.
2) The physical type or function of the project does not match the type or function of the impacted resource.

C8. Restoration Design Process Used

Minimum

(Multiplier = 1.0)

All projects should be checked against regional curves for cross sectional area, mean depth, and bankfull width, where such data are available from the Iowa DNR. A separate analysis should be provided for channel competence on given slope (for grade control structures), existing aggradation/degradation issues, and lateral stability problems. The causes of these issues should be theorized in a report. The project plan set should contain a full survey of existing conditions, including planview, cross sections at riffles and pools extending beyond the bank full channel, longitudinal profile stationed at the river's centerline including a minimum of 300 feet upstream and downstream of the project area, a description of dominant bed and bank materials, a contour map with typical low-flow edge of water defined, and photographs of the project area from various angles and stations to capture the bed, cross sections, and bank conditions. LiDAR is sufficient for out-of-bank areas but not for the bankfull and lower channel. Elevation profiles using LiDAR can be created using the DNR's online tool at https://programs.iowadnr.gov/maps/floodplain/elevation/. The project area's planset should also include planview, cross sections at riffles and pools extending beyond the bank full channel, longitudinal profile stationed at the river's centerline, a description of design bed composition and /or competence for overall design slope and individual riffle-run facet slopes, a contour map with proposed typical low-flow edge of water defined, and typical design details of any specific structures being applied.

Reference Reach Used

(Multiplier = 1.1)

A stable reference reach of two or more meandered wavelengths within the HUC-8 watershed should be used as a model for dimensions and pattern of the mitigation project. The reference reach must be in a similar valley type (i.e., lacustrine, alluvial depositional, etc.) as the mitigation site or match its potential. Cross sections, longitudinal profile (noting water surface, bed, and bankfull slopes), and statistical particle size data for active bed riffles, pools, runs, and glides must be included along with a report describing the effects of the reference reach on the on the design, factoring for drainage area and site-specific conditions. Elevation data resulting from surveys must also be included digitally in a spreadsheet or *.csv format for both the reference reach and mitigation reach sites.

NCD Checklist Completed

(Multiplier = 1.2)

The natural channel design checklist (developed by Will Harman) or a pre-approved functional equivalent, along with all described illustrations, figures, tables, and construction drawings and analysis reports for all process benchmarks, will be submitted along with digital points files for the existing conditions survey. Links to the current version of this checklist are available on the Iowa DNR mitigation tools web page. The applicant must thoroughly respond to all items in the checklist as well as any questions posed by the reviewer. Elevation data resulting from surveys must also be included digitally in a spreadsheet or *.csv format for both the reference reach and mitigation reach.

C9. Monitoring Design

Minimum

(Multiplier = 1.0)

Surveyed cross sections at design riffles and pools will be submitted three times over five years after construction, including year five as mandatory. On the same visit as the survey, stationed photos from various angles showing treatments, plantings, and structures will be submitted. Identification of plant species present and a rough assessment of success of plantings will be included in the report. Elevation data must also be included digitally in a spreadsheet or *.csv format for both the reference reach and mitigation reach.

Thorough Physical Stability

(Multiplier = 1.1)

Bed conditions will be thoroughly monitored against predictions and unforeseen conditions two times over five years after construction, including year five as a mandatory year, with preference given to surveying within a year of an out-of-banks flood between construction and year five. Predictions will be made concerning aggradation, degradation, and lateral stability (widening or migration). Monitoring will include re-survey and overlays of cross sections, profile, and plan view water's edge, and bankfull elevations. The natural channel design checklist (Harman and Starr, 2011) will be used for monitoring protocols and will be submitted along with all described calculations, illustrations, figures, tables, and drawings and analysis reports. Digital points files for all surveys must be provided digitally in a spreadsheet or *.csv format.

Complete Physical and Biological Monitoring

(Multiplier = 1.2)

Healthy stream function can be validated through improved biodiversity of aquatic life (Harman et al., 2012). All elements of "thorough physical stability monitoring" will be included, along with results of habitat assessment and aquatic species monitoring conducted pre- and post-project, with post-project biological surveys conducted within two weeks before or after the physical surveys. Iowa DNR protocols must be used that result in before-and-after score comparisons for indices of habitat, biological integrity (IBI) benthic macroinvertebrates (BMIBI), fish (FIBI), and mussels (MIBI) resulting in an overall IBI score for each sampling effort. Proximity to certain structures or treatments may be required to correlate with larger research projects. An analytical report describing suspected habitat successes or impacts on the site will be submitted, along with raw data provided in spreadsheet, *.csv, and/or GIS formats.

D. Riparian Buffer Work

Properly vegetated riparian buffers serve important stream functions including sediment trapping, nutrient cycling, stream shading, energy dissipation, natural moderation of floods, bank stability, natural wetland development, and delivery of organic matter to the stream. Mitigation work within the riparian buffer means implementing physical augmentation of the stream riparian buffer to improve water quality and/or ecosystem function and should strive to mimic the native composition, density, and structure of a fully functional stream situated within the same watershed. When determining corridor width, resource professionals should consider stream size, stream slope, drainage area, need for filtering runoff, stability of the stream, life history requirements of resident species, potential for stream bank erosion, longitudinal and horizontal migration, and floodplain interaction frequency.

In most cases, riparian buffer projects are not intended to stand alone as the mitigation projects, and in-stream benefits should also be included in the overall project plan. Riparian buffers are also not intended to extend beyond the top of a river's valley walls. However, care should also be taken not to add in-stream features to a stable or reference quality stream for the sole purpose of making a buffer project work. The reviewer may determine on a case-by-case basis whether exceptions are appropriate.

The Riparian Buffer Worksheet is located in Appendix I-D. Total credits generated per column are equal to the sum of the factors (sections D1 – D5), multiplied by area of the buffer (D6), multiplied by a factor of 0.002. Separate columns must be calculated for each type of net benefit (D1) and each functional zone (D2). Users should note that buffers on each side of the channel can generate mitigation credit separately or together. Buffers are not required to be uniformly wide and run parallel to the stream bank. Instead, buffers may be highly irregular within the existing meander belt of the stream.

The minimum buffer width (MBW) for which mitigation credit will be considered is 50 feet as measured perpendicular to flow from top of bank on each side of the stream. Smaller buffer widths may be allowed on a case-by-case basis for small streams, and consideration for a reduced buffer width will be based on issues related to construction constraints, land ownership, and land use activities.

An annotated plan-view map with corresponding cross sections should be included in plans that clearly illustrates distinct buffer areas (by both net benefit category and functional zone). LiDAR-derived cross-sections are generally acceptable; however, surveyed cross-sections may be required at the Corps discretion when significant channel migration has occurred or when the top-of-bank is difficult to distinguish using LiDAR.

D1. Net Benefit Factor

Net benefit is based on the percent of physical augmentation to the riparian buffer.

Restoration/Establishment
(Buffer benefit factor = 1.6)
Undesirable vegetation will be removed and regionally-appropriate native vegetation will be established in >50% of the buffer area.

Enhancement
(Buffer benefit factor = 0.8)
Undesirable vegetation will be removed and regionally-appropriate native vegetation will be established in 10-50% of the buffer area.

<u>Preservation</u>

(Buffer benefit factor = 0.6)

Riparian area will be conserved in its naturally-occurring or present condition to prevent its destruction, degradation, or alteration in order to prevent the decline of functions within the stream it is buffering. For the purposes of this guidance, an area will be considered as riparian buffer preservation if <u>less than 10%</u> of the area would require planting of vegetation to maintain important aquatic resource functions.

User Notes:

1. Credit cannot be obtained for multiple mitigation activities within the same riparian corridor along the same side of the stream (e.g., credit is not allowed both for preservation of 500 linear feet of existing corridor and for the establishment of 500 linear feet of buffer along the same channel segment). However, the same feet of corridor cannot be eligible for more than one activity (i.e., when the broad floodplain is restored, additional credit is not given for that same area's long-term preservation, as that is assumed to be the case after restoration). Only regionally-appropriate native plantings should be used in restoration projects, and elevation relative to the stream should be considered when choosing planting types.

2. The buffer percentages expressed above shall be calculated for each side of the channel that will be buffered and for which mitigation credit is being sought. For example, twenty feet of native buffer currently exists perpendicular to the channel resulting in a planting area of 30 feet to establish the 50 foot wide buffer. Therefore, 60% of the total planting area qualifies for riparian buffer restoration/establishment credit.

3. Streams which are recognizably unstable, entrenched, or otherwise disconnected from their floodplains, and which require extensive stream bed and/or bank restoration are not considered good candidate streams for solely producing riparian buffer credit, unless the mitigation plan is accompanied by in-stream mitigation practices that address the baseline problems. However, under some circumstances the Corps district, in consultation with the reviewing resource agencies, may entertain a setback from the top of stream bank to accommodate changes in the stream's dimension, pattern, and profile as the channel responds to regional influences predicted to occur in the watershed. No riparian net benefits will be determined for the setback area due to the instability and eventual loss of ground. However, a net benefit value can be assigned for buffer establishment beyond the setback zone.

D2. Functional Zone

For most regions of Iowa, lateral stability of streams can be achieved when streams are allowed to meander freely within a belt at least four times as wide as the bankfull width of the stream. Buffers within this zone are likely to provide the greatest physical, hydrological, biological, and chemical benefits to the stream. Additional efforts to protect land and establish regionally-appropriate native vegetation within the broad floodplain and even on steeper valley sides are likely to provide additional benefits to the stream. These zones are illustrated in Figures 1 through 3, and additional instructions for determination of bankfull width are provided in the Definitions section (F). Areas outside these zones will not receive buffer credit.

<u>Near-stream zone</u>

(Buffer function factor = 1.2)

The buffer is in the near-stream zone when it is located adjacent to the stream in the area up to 4-times the bankfull width of the stream. For most streams, this zone includes a meander belt centered around the stream (Figure 1), but this area may be shifted to one side when the stream corridor is restricted by a valley wall (see Figures 2 and 3).

<u>Broad floodplain zone</u>

(Buffer function factor = 0.6)

Buffer is located within the broad floodplain. Buffers in this zone will not be given credit unless this buffer is a continuation of buffer located in the near-stream zone. If floodplain data are available, the area below the 500-year flood elevation may be considered part of this zone.

Valley walls

(Buffer function factor = -0.5)

The buffer is located outside of the floodplain as determined by a distinct break in slope in the valley profile (Figure 2). Only buffers that are adjacent to buffers in the near-stream and broad floodplain zones are eligible for mitigation credits. Although this factor is negative, buffer projects within this zone will result in additional buffer credits.

Figure 1: Typical valley cross-section where valley is formed in soft sediments.

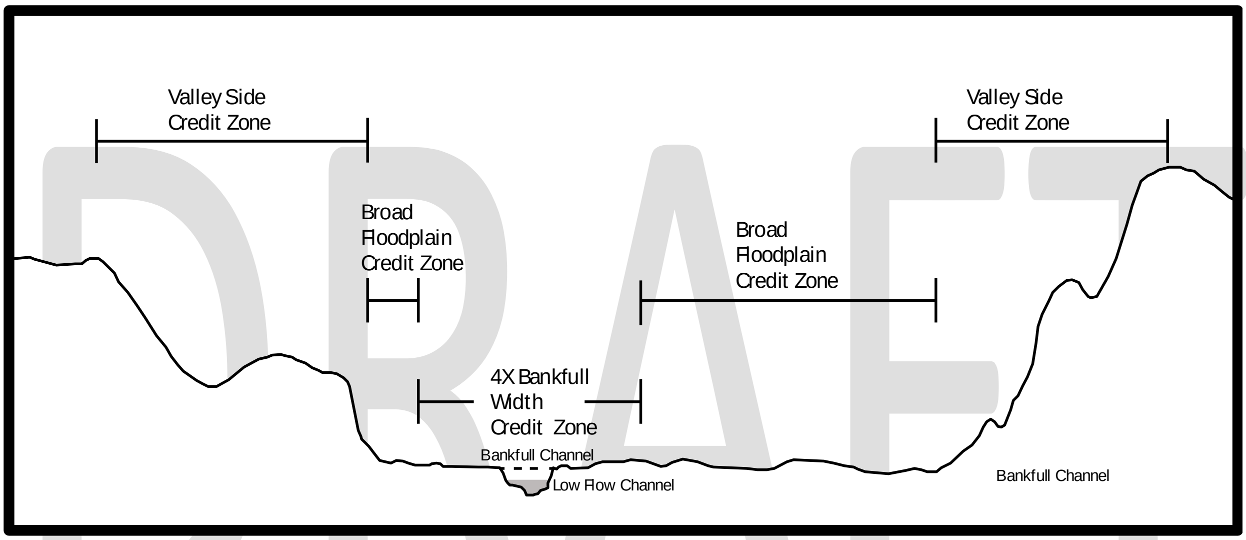
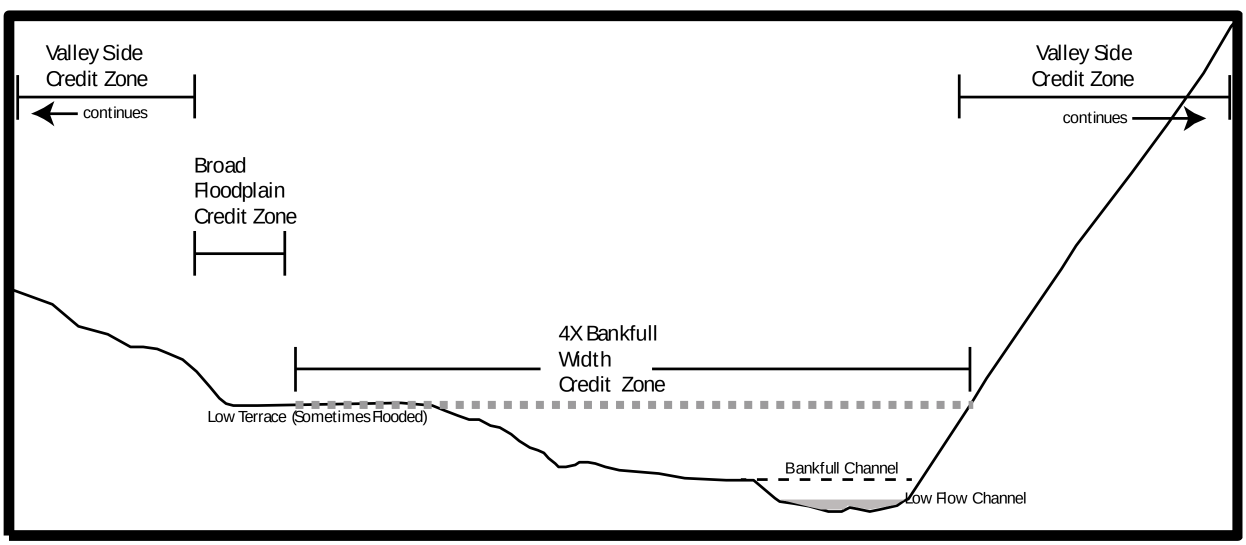
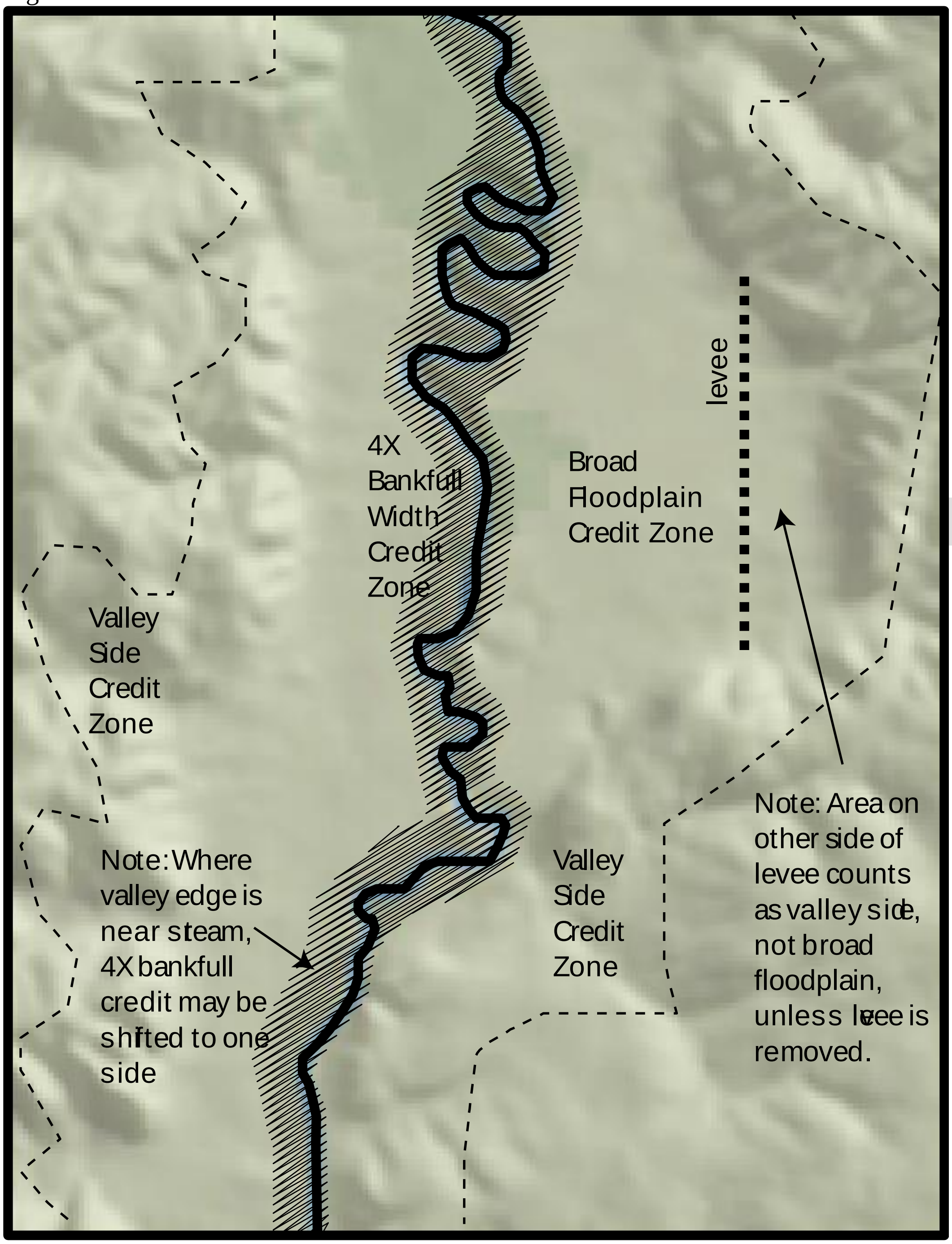


Figure 2: valley cross-section, where channel is up against a steep valley wall as often occurs in valleys that cut through sedimentary rock formations.



Note that low terraces can be part of the 4X bankfull width credit zone but that the zone favors the low side. The 4X bankfull width credit zone includes both sides up to the low terrace elevation.

Figure 3: Plan-view of zones of buffer function.



D3. Site Protection Bonus

(Buffer factor = 0.2, can only be only used once)
See Section C2. This site protection bonus can be used when a qualified third-party agrees to guarantee protection of a site in perpetuity under a pre-approved legal instrument. No additional credits are generated on the riparian buffer worksheet where the majority of credits are obtained from in-channel mitigation in the reach. In other words, this factor can only be used once in the more significant credit-generating worksheet for of the project. The site protection bonus can only be applied once for a given piece of property regardless of whether both in-stream and riparian activities are planned.

D4. Credit Schedule

(Buffer factor = 0 to 0.15)
See Section C3. No additional credits are generated on the riparian buffer worksheet where the majority of credits are obtained from in-channel mitigation in the reach. In other words, this factor can only be used once in the more significant credit-generating worksheet for of the project.

D5. Temporal Lag

(Buffer factor = 0 to -0.3)
Temporal lag takes into account the time required for riparian vegetation in a mitigation area to fully replicate the riparian vegetation size and age class lost at the impact site. Depending on the type of vegetation that occurred at the impact site, the riparian buffer targeted for restoration, establishment or enhancement at the mitigation site will require different lengths of time to reach a commensurate level of maturity that existed at the impact site.

Temporal Lag	Buffer Factor
Over 20 years	- 0.3
10 – 20 years	- 0.2
5 – 10 years	- 0.1
0 – 5 years	0

D6. Determining Buffer Area

The buffer area is defined by the area for which preservation, enhancement, or restoration of the buffer will occur and does not include the channel between the top-of-banks. All proposed buffer areas must be adjacent to the stream or adjacent to buffer areas previously approved for mitigation at the discretion of the Corps. If proposed buffers are not adjacent to the stream, credits must be carefully reviewed to ensure that there is no duplication of buffer credits from previous projects. The length of stream and width of buffers should be marked on applicant's maps of proposed buffer areas and noted in the Riparian Buffer Worksheet (Appendix I-D). Buffer area should be determined directly from the dimensions of a digital shape file.

D7. Location & Kind Factor

See section C7. This factor only applies to permittee-responsible projects.

E. Fish Passage

Dams, road culverts, and other structures can limit fish passage to upstream waters. Carefully-designed projects can greatly benefit communities and fisheries. Over 200 dams in Iowa have been pre-scored based on multiple factors that reflect level of impact on fish movement and other aquatic species impacts due to habitat fragmentation. Scoring factors include difference in species richness downstream and upstream, presence of game species, presence of invasive/undesirable species, and dam height. Together these factors have been used to prioritize dam mitigation projects. Users should note that most dam mitigation projects require a significant investment of time to build community support for such a project, in addition to the extensive planning necessary to ensure a successful project. Credit for dam mitigation as stream mitigation will only be granted if community support is well-documented and sufficient resources for successful installation are available. (See "Solving Dam Problems," Chapter 4: Mitigation Alternatives, at http://www.iowadnr.gov/Recreation/CanoeingKayaking/LowHeadDams/DamMitigationSafety.aspx as a reference.)

Basic design criteria for allowable fish passage for mitigation purposes include the following:

1) The lowest portion channel must have a profile slope not exceeding 5 percent. If multiple chutes or channels exist, the lowest must favor the low-slope channel designed for fish. This can be accomplished by setting its elevation 0.5 feet lower than other chutes at the crest.
2) If project structures are used with slopes at 1 percent to 5 percent, the channel bed must be heavily roughened (Manning's n value of 0.5 or greater) in the portion of the cross section used for fish passage.
3) Minimum width from low-flow water's edge to water's edge of the fish passage area should be approximately 10 feet, but can be smaller at the reviewers discretion for streams with low-flow width of less than 20 feet.
4) Structure should be deemed stable, using adequate sizing of material to remain competent or grouting to hold the bed together. In the case of grouting, permanent maintenance assurances must be provided to guarantee structural integrity in perpetuity.
5) Further specifications and criteria can be found in the Minnesota DNR's technical manual *Reconnecting Rivers*: http://www.dnr.state.mn.us/eco/streamhab/reconnecting_rivers.html.

Credits for fish passage will be calculated by multiplying the Benefit factor (E1) by the number of linear miles impacted (E2) by 100. Thus, the maximum number of credits generated by dam mitigation is 50,000 (1.0 x 500 x 100).

E1. Benefit Multiplier

(Fish passage multiplier ranges from 0.1 to 1.0)
Any structure on a perennial stream is assumed to have a minimum value of 0.1. A pre-scored table of dams with watershed greater than 50 square miles will be available on the DNR's River Restoration website http://www.iowadnr.gov/Environmental-Protection/Water-Quality/River-Restoration.
For dams not appearing on the table, additional data may be presented to show benefits that raise the multiplier to the maximum allowable value of 1.0. These factors include diverse species richness downstream, presence of game species, presence of invasive/undesirable species, and dam height. Functional Asian Carp barrier dams identified by the Iowa DNR will not be considered for mitigation. Any structure with a low-flow hydraulic height (from headwater to tail water) of a half foot or less or that has normal velocities at a range of flows with 2 feet per second or less will not be not considered a fish barrier for mitigation purposes.

E2. Perennial Stream Miles Upstream

(Miles range from 1 to 500)
The number of perennial stream miles upstream of the structure that will benefit from dam removal or modification will be used for credit calculation. Credit will not be granted for more than 500 miles of benefit; therefore, the maximum number of credits for fish passage for each project is 50,000.

F. Glossary

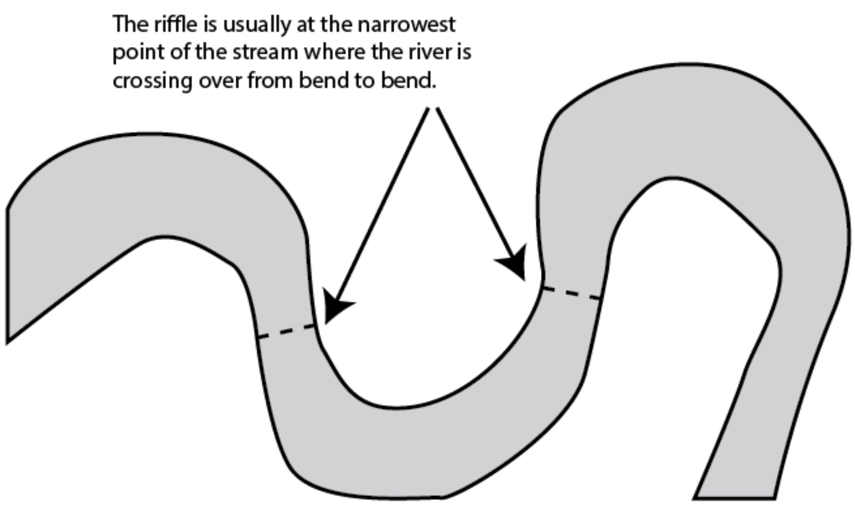
The glossary identified below is not intended to be an exhaustive list; rather, this list has been compiled based on those terms that are repeatedly used or where the universal definition of the term has substantial variability. Many of the terms used throughout this document are defined in other sources such as the Mitigation Regulation or the document referenced in Appendix G, “Glossary of Stream Restoration Terms.”

Bankfull Discharge is the maximum discharge that the channel can convey without overflowing onto the floodplain or bench and is considered the channel forming discharge.

Bankfull Stage is the point at which water begins to overflow onto a floodplain.

Bedload Transport Zone is the stream channel zone where bed load is effectively transported and deposited.

Bankfull Width is the width of the stream channel at bankfull discharge. The bankfull width should be measured perpendicular to the stream in a riffle section (straight section between pools) as shown in the figure below.



In cross-section, the bankfull width is the distance between points on opposing banks where the channel encounters its lowest floodplain. This low floodplain occurs between the one- and two- year flood recurrence elevation. Bankfull width may be approximated using topographic data and measuring from top-of bank to top-of-bank or by measuring at multiple riffles within or near the project area.

Biological Processes are the processes of living organisms in contiguous systems. Biologic processes are influenced by hydrologic, hydraulic, geomorphic, and physiochemical functions. Therefore, restoration projects that are intended to restore biologic function must consider all of these functions within the watershed.

Buffer means an upland, wetland, and/or riparian area that protects and/or enhances aquatic resource functions associated with wetlands, rivers, streams, lakes, marine, and estuarine systems from disturbances associated with adjacent land uses.

Channel Dimension is the stream's cross-sectional area (calculated as bankfull width multiplied by mean depth at bankfull). Changes in bankfull channel dimensions correspond to changes in the magnitude and frequency of bankfull discharge that are associated with water diversions, reservoir regulation, vegetation conversion, development, overgrazing, and other watershed changes. Stream width is a function of occurrence and magnitude of discharge, sediment transport (including sediment size and type), and the streambed and bank materials.

Channel Features include riffles, runs, pools, and glide habitat that maintain channel slope and stability and provide diverse aquatic habitat. A **riffle** is a bed feature where the water depth is relatively shallow and the slope is steeper than the average slope of the channel. At low flows, water moves faster over riffles, which provides oxygen to the stream. Riffles are found entering and exiting meanders and control the streambed elevation. A **run** is characterized by fast- flowing, low turbulence flow. A **pool** is much deeper than the average channel depth and has low-velocity water and a smooth surface. A **glide** is the section of stream that has little or no turbulence.

Ecological Drainage Units (EDU) consist of Aquatic Subregions within Iowa and are based on combining watersheds containing aquatic assemblages that are geomorphically similar and are distinct within the context of the surrounding watersheds.

Enhancement means the manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s) but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area but is an improvement to the value of particular aspects of the stream and/or related land resources.

Ephemeral Streams only have flowing water in response to precipitation events during a normal precipitation year. Ephemeral streambeds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from precipitation is the primary source of water for stream flow. Ephemeral streams typically support few aquatic organisms. When aquatic organisms are found they typically have a very short aquatic life stage.

Geomorphic Function is directly influenced by hydrologic and hydraulic processes. As water flows through streams it is affected by the kinds of soils and alluvial features within the channel, in the floodplain, and in the uplands. The amount and kind of sediments carried by a stream largely determines its equilibrium characteristics, including size, shape, and profile. Restoration of geomorphic function requires an understanding of how water and sediment are related to channel form and function and on what processes are involved with channel evolution.

Hydraulic Function is the transport of water in the channel, on the floodplain, and through sediments. Restoration of hydraulic function requires an understanding of how water flows into and through stream corridors as well as how fast, how much, how deep, how often, and when it flows (i.e., timing, frequency, duration, magnitude, rate of rise, and rate of decline).

Hydrologic Balance an accounting of all water inflow to, water outflow from, and changes in water storage within a hydrologic unit over a specified period of time.

Hydrologic Function is the exchange of water between the channel and watershed. Two formats are especially useful for planning and designing stream corridor restoration: **Flow duration** which is the probability a given streamflow was equaled or exceeded over a period of time. **Flow frequency** is the probability a given streamflow will be exceeded (or not exceeded) in a year.

Intermittent Streams have flowing water during times of the year when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from precipitation is a supplemental source of water for stream flow. The biological community of intermittent streams is composed of species that are aquatic during a part of their life history or move to perennial water sources. Intermittent streams with 5 or more perennial pools per 0.5 miles are included in this category.

Linear Feet means the length of stream, measured in feet, that will be impacted by an impact activity, as authorized under Section 404 of the Clean Water Act, and for which mitigation will be required.

Mean Depth at Bankfull is the mean depth of the stream channel cross-section at bankfull stage as measured in a riffle section.

Ordinary High Water Mark (OHWM) is the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of the soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding area (for more detail see Regulatory Guidance Letter 05-05 dated 7 December 2005).

Oxbow Habitats are off-channel aquatic habitats, sometimes seasonal, that are periodically connected by floods (approximately 10-year recurrence interval or less) to the stream, thus allowing for biological and nutrient exchange.

Physiochemical Function involves the chemical processes and reactions that occur between water, soils, rocks, and living organisms, and the transport of chemical components within the watershed over time. Restoration activities may interact in a variety of complex ways with water quality, affecting both the delivery and impact of water quality stressors or enhancers.

Perennial Streams have flowing water year-round during a normal precipitation year. The water table is located above the streambed for most of the year. Groundwater is a primary source of water for stream flow. Runoff from precipitation is a supplemental source of water for stream flow. Perennial streams support aquatic organisms year-round.

Public natural areas include any land owned by conservation organizations, counties, state or federal agencies, or private easements that are public accessible.

Riparian Areas are lands adjacent to streams, rivers, lakes, and estuarine marine shorelines. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality.

Restoration means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource.

Streams include all flowing surface-water systems (perennial, intermittent, and ephemeral) that contain an ordinary high water mark and are determined to be jurisdictional “Waters of the United States” as defined by 33 CFR 328.3 (streams are natural, man-altered, or man-made tributaries that flow directly or indirectly into traditional navigable waters).

Stream Profile The profile of a stream refers to its longitudinal slope. At the watershed scale, channel slope generally decreases in the downstream direction with commensurate increases in stream flow and decreases in sediment size. Channel slope is inversely related to sinuosity, so steep streams have low sinuosities and flat streams have high sinuosities.

Stream Reach is any defined length of river, creek, or tributary per a “Water of the United

States” delineation, identified in engineering plans, or in a compensatory mitigation plan.

Stream Order is a ranking system for tributaries defined between points of confluence. Headwater streams are considered first order streams. When two streams of like order meet, the segment downstream is assigned one order greater than those that feed it. For a discussion of the order of tributaries, see Alan Needle Strahler’s 1952 article “Dynamic Basis of Geomorphology” in the *Geological Society of America Bulletin.*

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APPENDIX I

I-A: Summary Information Sheet
I-B: Adverse Impact Factors Worksheet
I-C: In-Stream Work Worksheet
I-D: Riparian Buffer Worksheet
I-E: Fish Passage Worksheet

I-A: SUMMARY INFORMATION WORKSHEET

Project Name:
Project Sponsor:
Proposal Date:
Principal Contact:

Type of Mitigation: Permittee-Responsible Mitigation, In-Lieu Fee Project, Mitigation Bank Project

Credit Summary:

Adverse Impact Debits
In-Stream Benefit Credits
Riparian Benefit Credits
Fish Passage Credits

Are credits > impacts?

I-B: ADVERSE IMPACT FACTORS WORKSHEET

<table>
<tr><td>B1</td><td>Stream Type</td><td colspan="3">Ephemeral
0.3</td><td colspan="3">Intermittent
0.4</td><td colspan="3">Perennial
0.8</td></tr>
<tr><td>B2</td><td>Priority Waters</td><td colspan="3">Tertiary
0.1</td><td colspan="3">Secondary
0.4</td><td colspan="3">Primary
0.8</td></tr>
<tr><td>B3</td><td>Existing Condition</td><td colspan="3">Functionally Impaired
0.2</td><td colspan="3">Moderately Functional
0.8</td><td colspan="3">Fully Functional
1.6</td></tr>
<tr><td>B4</td><td>Impact Duration</td><td colspan="4">Temporary
0.05</td><td colspan="5">Permanent
0.3</td></tr>
<tr><td>B5</td><td>Impact Activity</td><td>Clearing
0.05</td><td>Temp. disturb-ance
0.15</td><td>Below grade culvert
0.3</td><td>Armor
0.5</td><td>Deten-tion facility
0.75</td><td>Morph-ologic change
1.5</td><td>Impound-ment
2.0</td><td>Pipe
2.2</td><td>Fill
2.5</td></tr>
<tr><td>B6</td><td>Linear Impact Calculation</td><td colspan="9">0.0002 multiplied by linear feet of stream impact recorded in each column below</td></tr>
<tr><td>B7</td><td>Compensation Ratio (CR)</td><td colspan="3">Primary Service Area
1.0</td><td colspan="3">Secondary Service Area
2.0</td><td colspan="3">Tertiary Service Area
3.0</td></tr>
</table>

	Impact 1	**Impact 2**	**Impact 3**	**Impact 4**	**Impact 5**
Stream Type					
Priority Waters					
Existing Condition					
Impact Duration					
Impact Activity					
Linear Impact Calculation					
Sum of Factors (M)					
Linear Feet of Stream Impact (LF)					
Debits (D) = M × LF					
Compensation Ratio* (CR)					
Total Debits = (D × CR)					

Total debits from sum of all Columns = _______

*Applies to in-lieu fee or mitigation bank projects only.

I-C: IN-STREAM BENEFITS WORKSHEET

C1	**Stream Type**	Ephemeral 0.15	Intermittent 0.2	Perennial Stream 0.4	
C2	**Priority Waters**	Tertiary 0.05	Secondary 0.2	Primary 0.4	
C3	**Net Benefit**	Stream Relocation 0.5	Moderate 1.2	Good 2.4	Excellent 3.5
C4	**Site Protection Bonus**	No third-party grantee 0	Third-party grantee 0.2		
C5	**Credit Schedule**	Schedule 1 0.3	Schedule 2 0.1	Schedule 3 0	
C6	**Location and Kind***	In-service-area/In-kind 1.0	Out-of-service-area/Out-of-kind 0.5		
C7	**Design Process**	Minimum 1.0	Stability Analysis 1.1	Full NCD Checklist 1.2	
C8	**Monitoring Process**	Minimum 1.0	Stability 1.1	Complete Physical & Biological 1.2	

	Net Benefit 1	Net Benefit 2	Net Benefit 3	Net Benefit 4	Net Benefit 5	Net Benefit 6
Stream Type						
Priority Waters						
Net Benefit						
Site Protection						
Credit Schedule						
Sum Factors (M)						
Linear Feet of Stream Benefited (LF)						
Reach Credits (C) = M × LF						
Location & Kind* (LK)						
Design Process (DP)						
Monitoring Process (MP)						
Total Credits = (C x LK x DP x MP)						

Total Instream Credits Generated from all Columns = ________

*Applies to permitee-responsible projects only.

I-D: RIPARIAN BUFFER WORKSHEET

D1	**Net Benefit Factor**	Riparian Restoration/ Establishment 1.2	Enhancement 0.8	Preservation 0.5	
D2	**Function Factor**	4× Bankfull Width 1.2	Broad Floodplain 0.5	Valley Sides - 0.6	
D3	**Site Protection**	No third-party grantee 0	Third-party grantee 0.2		
D4	**Credit Schedule**	Schedule 1 0.15	Schedule 2 0.05	Schedule 3 0	
D5	**Temporal Lag**	Over 20 years - 0.3	10 to 20 years - 0.2	5 to 10 years - 0.1	0 to 5 years 0
D6	**Buffer Area**	Measured in square feet (digital measurements preferred)			
D7	**Location and Kind***	In-service-area/In-kind 1.0	Out-of-service-area/Out-of-kind 0.5		

For reviewer's information, please note the following dimensions for each proposed buffer area:
1) Stream length benefitted
2) Average buffer width measured perpendicular to the bank or from the centerline of the existing meander belt, if the proposed buffer will extend beyond the existing meander belt.

		Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
For reviewer's information only:	Stream length						
	Average width						
Net Benefit Factor							
Function Factor							
Site Protection Bonus							
Credit Schedule							
Temporal Lag							
Sum Factors (M)							
Buffer area in square feet (BA)							
Buffer Credits Subtotal (C) = M × BA × 0.002							
Location & Kind* (LK)							
Total Credits = C × LK Factor							

Total Riparian Credits Generated from all Columns = _______

* Applies to permittee-responsible mitigation projects only.

I-E: FISH PASSAGE WORKSHEET

E1	**Benefit Multiplier**	Value from 0.1 – 1.0 from DNR table
E2	**Perennial Stream Miles**	Up to 500 miles

	Dam 1
Benefit Multiplier (E1)	
Perennial Stream Miles (E2)	
Fish Passage Credits Subtotal (C) = E1 × E2 × 100	
Location & Kind* (LK)	
Total Fish Passage Credits = C × LK Factor	

APPENDIX II

APPENDIX III

U.S. Army Corps of Engineers Priority Segments